

Claims

1. A method for producing calendered paper by means of an off-line calender, in which method a paper web (W) manufactured and
5 moistened in a paper machine and reeled on a machine reel is calendered in a multinip calender (1) arranged apart from the paper machine, said multinip calender being formed of rolls (14) having a flexible coating and heated rolls (4) placed alternately against each other in such a manner that a nip (N1, N2, N3, N4, NC, N1', N2', N3',
10 N4') is formed between successive rolls (14, 4),

characterized in that

- the paper web (W) is calendered in the multinip calender (1) whose roll assembly is formed of a first set of rolls (2) and a second set of rolls (3) in the travel direction of the paper web (W), and that
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- at least one surface (S1, S2) of the paper web is moistened with at least one pre-moisturizer (8, 8', 8''), whereafter the paper web (W) is passed to the first calender nip (N1) of the first set of rolls (2) and one surface (S1, S2) of the paper web is moistened with at least one intermediate moisturizer (9, 9'), whereafter the paper web (W) is guided to the first calender nip (N1') of the second set of rolls (3), wherein
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- as a result of calendering a paper web (W) having roughness of 1,0 – 1, 1 μ m and/or gloss of 54 – 57 % or 56 – 60 % is produced.
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2. The method according to claim 1, **characterized** in that one surface (S1, S2) of the paper web is moistened before the paper web (W) is passed to the first calender nip (N1) of the first set of rolls (2), and the
30 opposite surface (S1, S2) of the paper web is moistened before the paper web (W) is guided to the first calender nip (N1') of the second set of rolls (3).

3. The method according to claim 1, **characterized** in that both
35 surfaces (S1, S2) of the paper web are moistened before the paper web (W) is guided to the first calender nip (N1) of the first set of rolls

(2), and one surface (S1, S2) of the paper web is moistened before the paper web (W) is passed to the first calender nip (N1') of the second set of rolls (3).

- 5 4. The method according to any of the claims 1 to 3, **characterized** in that at least one surface (S1, S2) of the paper web (W) is moistened when the paper web (W) is supported against a supporting roll (7) or a guide roll (5).
- 10 5. The method according to any of the claims 1 to 3, **characterized** in that at least one surface (S1, S2) of the paper web (W) is moistened when the paper web (W) travels in a free draw.
- 15 6. The method according to claim 2 or 3, **characterized** in that at least one pre-moisturizer (8, 8', 8'') and at least one intermediate moisturizer (9, 9') is positioned in the travel direction of the paper web (W) on the opposite sides of the web in such a manner that the absorption time of the moistening medium sprayed by at least one pre-moisturizer (8, 8', 8'') and intermediate moisturizer (9, 9') on the opposite surfaces (S1, S2) of the paper web (W) is substantially the same.
- 20 7. The method according to claim 1, **characterized** in that the paper web (W) is guided to the first calender nip (N1) of the first set of rolls (2) and to the first calender nip (N1') of the second set of rolls (3), which calender nips (N1, N1') are arranged in such a manner that the surface (S1, S2) of the paper web (W) moistened by means of at least one pre-moisturizer (8, 8', 8'') and/or intermediate moisturizer (9, 9') is pressed against the heated roll (4, 4', 4'') in the nip (N1, N1').
- 25 8. The method according to claim 1, **characterized** in that the paper web (W) is calendered in the multinip calender (1) in which the first set of rolls (2) and the second set of rolls (3) are arranged in separate stacks of rolls.
- 30 9. The method according to claim 1, **characterized** in that the paper web (W) is calendered in the multinip calender (1) in which the first set

of rolls (2) and the second set of rolls (3) are arranged successively in a way that they share one roll nip (NC).

5 10. The method according to claim 1, **characterized** in that the moistening of the paper web (W) and the multinip calender (1) are controlled by means of a control unit (13).

10 11. The method according to claim 10, **characterized** in that the moisture content of the paper web (W) is measured and the supply of moistening medium of at least one pre-moisturizer (8, 8', 8'') and/or intermediate moisturizer (9, 9'') is adjusted on the basis of a control signal determined from the moisture data of the paper web (W).

15 12. The method according to claim 10, **characterized** in that the moisture content and/or gloss of the paper web (W) are/is measured and the nip pressures of the nips (N1, N2, N3, N4, NC, N1', N2', N3', N4') of the multinip calender (1) and the temperature of the heated rolls (4, 4', 4'') are adjusted on the basis of a control signal determined from the moisture and gloss data of the paper web (W).

20 13. The method according to claim 1, **characterized** in that the paper grade to be calendered is selected from the following group: SC-A, SC-A+ or SC-B.

25 14. The method according to claim 13, **characterized** in that SC-A or SC-A+ paper is calendered, wherein the multinip calender (1) is formed in such a manner that the first set of rolls (2) and the second set of rolls (3) comprise four nips (N1, N2, N3, N4, NC, N1', N2', N3', N4') or the first set of rolls (2) and the second set of rolls (3) comprise five nips
30 (N1, N2, N3, N4, NC, N1', N2', N3', N4').

35 15. The method according to claim 13, **characterized** in that SC-B paper is calendered, wherein the multinip calender (1) is formed in such a manner that the first set of rolls (2) and the second set of rolls (3) comprise five nips (N1, N2, N3, N4, NC, N1', N2', N3', N4').

16. An apparatus for producing calendered paper by means of an off-line calender, said apparatus comprising

- 5 - an unwinder (15) for unwinding a paper web (W) produced and moistened in a paper machine and reeled on a machine reel,
- a multinip calender (1) formed of rolls (14) having a flexible coating and heated rolls (4) placed alternately against each other in such a manner that a nip (N1, N2, N3, N4, NC, N1', N2', N3', N4') is formed between successive rolls (14, 4),
- 10 - at least one guide roll (5),
- a reel-up (16) for reeling up the calendered paper web (W),

characterized in that

- 15 - the rolls (14) having a flexible coating and the heated rolls (4) forming the multinip calender (1) are arranged in such a manner that they form a first set of rolls (2) and a second set of rolls (3) in the travel direction of the web, and that
- the apparatus comprises at least one pre-moisturizer (8, 8', 8'') for moistening at least one surface (S1, S2) of the paper web (W) before guiding the paper web (W) to the first calender nip (N1) of the first set of rolls (2) and at least one intermediate moisturizer (9, 9') for moistening one surface (S1, S2) of the paper web (W) before guiding the paper web (W) to the first calender nip (N1') of the second set of rolls (3), wherein
- 20 - the roughness of the paper web (W) produced as a result of calendering is $1,0 - 1,1 \mu\text{m}$ and/or the gloss is 54 – 57 % or 56 – 60 %.
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17. The apparatus according to claim 16, **characterized** in that at least
30 one pre-moisturizer (8, 8', 8'') is arranged to moisten one surface (S1, S2) of the paper web before the paper web (W) is passed to the first calender nip (N1) of the first set of rolls (2), and at least one intermediate moisturizer (9, 9') is arranged to moisten the opposite
35 surface (S1, S2) of the paper web before the paper web (W) is passed to the first calender nip (N1') of the second set of rolls (3).

18. The apparatus according to claim 16, **characterized** in that at least one pre-moisturizer (8, 8', 8'') is arranged to moisten both surfaces (S1, S2) of the paper web before the paper web (W) is passed to the first calender nip (N1) of the first set of rolls (2), and at least one
5 intermediate moisturizer (9, 9') is arranged to moisten one surface (S1, S2) of the paper web before the paper web (W) is passed to the first calender nip (N1') of the second set of rolls (3).

19. The apparatus according to any of the claims 16 to 18,
10 **characterized** in that the apparatus comprises at least one supporting roll (7) and that at least one surface (S1, S2) of the paper web (W) is arranged to be moistened when the paper web (W) is supported against a supporting roll (7) or a guide roll (5).

15 20. The apparatus according to any of the claims 16 to 18, **characterized** in that at least one surface (S1, S2) of the paper web (W) is arranged to be moistened when the paper web (W) travels in a free draw.

20 21. The apparatus according to claim 17 or 18, **characterized** in that at least one pre-moisturizer (8, 8', 8'') and at least one intermediate moisturizer (9, 9') are positioned in the travel direction of the paper web (W) on the opposite sides of the web in such a manner that the absorption time of the moistening medium sprayed by at least one pre-
25 moisturizer (8, 8', 8'') and intermediate moisturizer (9, 9') on the opposite surfaces (S1, S2) of the paper web (W) is substantially the same.

22. The apparatus according to claim 16, **characterized** in that the first
30 calender nip (N1) of the first set of rolls (2) and the first calender nip (N1') of the second set of rolls (3) are arranged in such a manner that the surface (S1, S2) of the paper web (W) moistened by means of at least one pre-moisturizer (8, 8', 8'') and/or intermediate moisturizer (9, 9') is pressed against the heated roll (4, 4', 4'') in the nip (N1, N1').

23. The apparatus according to claim 16, **characterized** in that the first set of rolls (2) and the second set of rolls (3) are arranged in separate stacks of rolls.
- 5 24. The apparatus according to claim 16, **characterized** in that the first set of rolls (2) and the second set of rolls (3) are arranged successively so that they share one roll nip (NC).
- 10 25. The apparatus according to claim 16, **characterized** in that the apparatus comprises a control unit (13) for controlling the moistening of the paper web (W) and the multinip calender (1).
- 15 26. The apparatus according to claim 25, **characterized** in that the apparatus comprises measurement devices (10, 11) for measuring the moisture content of the paper web (W) and that the control unit (13) is arranged to determine a control signal from the moisture data of the paper web (W) for adjusting the supply of moistening medium of at least one pre-moisturizer (8, 8', 8'') and/or intermediate moisturizer (9, 9'').
- 20 27. The apparatus according to claim 25, **characterized** in that the apparatus comprises a measurement device (12) for measuring the moisture and/or gloss of the paper web (W) and that the control unit (13) is arranged to determine a control signal from the moisture and gloss data of the paper web (W) to adjust the nip pressures of the nips (N1, N2, N3, N4, NC, N1', N2', N3', N4') of the multinip calender (1) and the temperature of the heated rolls (4, 4', 4'').
- 25 28. The apparatus according to claim 16, **characterized** in that the apparatus is arranged to calender a paper grade selected from the following group: SC-A, SC-A+ or SC-B.
- 30 29. The apparatus according to claim 28, **characterized** in that the apparatus is arranged to calender SC-A or SC-A+ paper, wherein the multinip calender (1) is formed in such a manner that the first set of rolls (2) and the second set of rolls (3) comprise four nips (N1, N2, N3,
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N4, NC, N1', N2', N3', N4') or the first set of rolls (2) and the second set of rolls (3) comprise five nips (N1, N2, N3, N4, NC, N1', N2', N3', N4').

- 5 30. The apparatus according to claim 28, **characterized** in that the apparatus is arranged to calender SC-B paper, wherein the multinip calender (1) is formed in such a manner that the first set of rolls (2) and the second set of rolls (3) comprise five nips (N1, N2, N3, N4, NC, N1', N2', N3', N4').